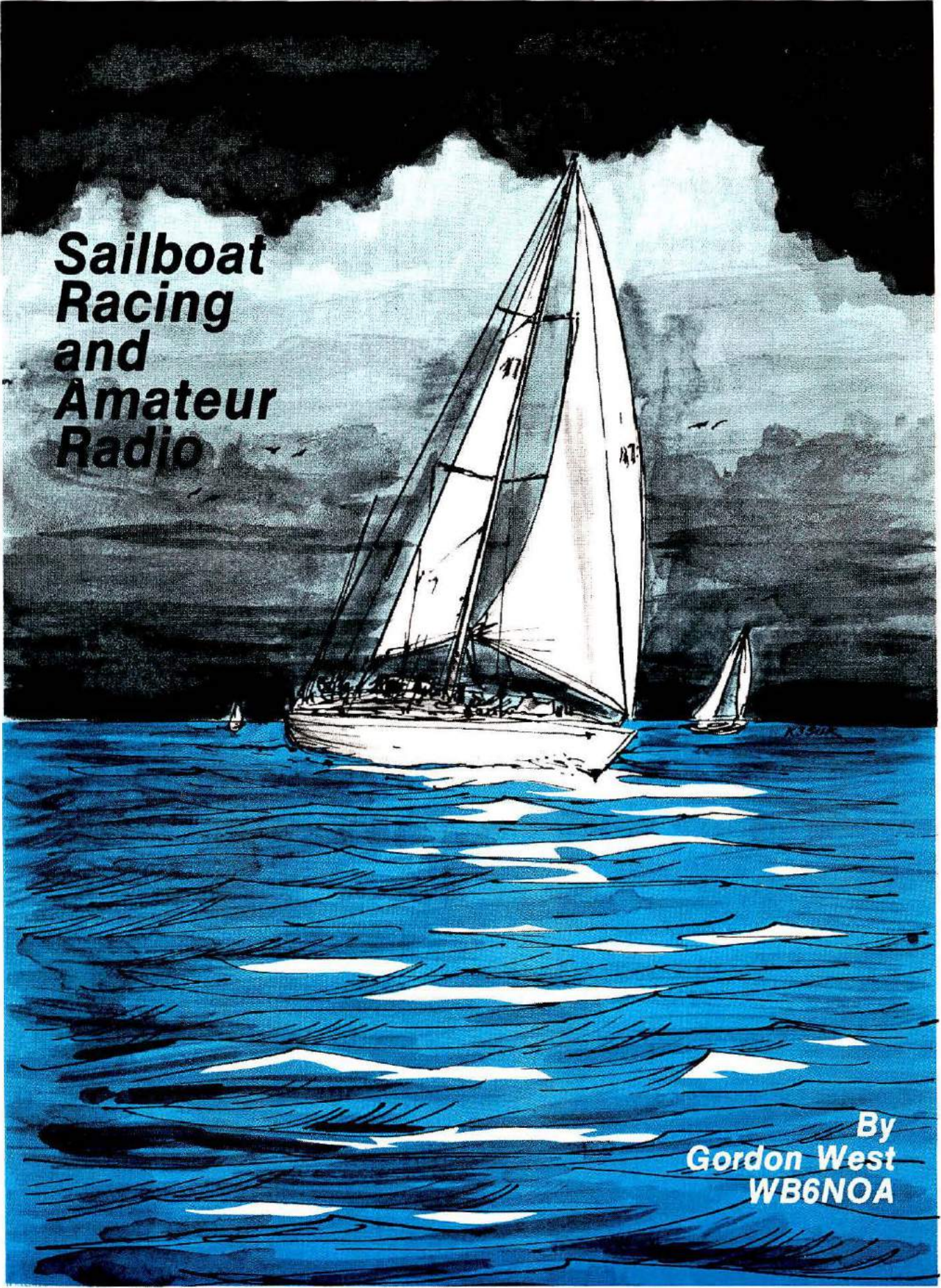




Sailboat Racing and Amateur Radio

By
Gordon West
WB6NOA

Looking for some exciting travel for your next vacation? How would you like to sail to the South Seas for an all-expenses-paid three-week stay? Some lucky amateur radio operators working with local yacht clubs are doing just that — enjoying a great vacation while providing necessary communications for a yacht club ocean-sailboat race. Yacht

Marine communications channels on vhf or ssb are used whenever possible. Most committees on long-distance races require vessels to have both high-frequency and very-high-frequency marine equipment, with emergency antennas for each band. Most communications are coordinated on precise schedules throughout the race.

vessels pool their information about the participants, the relative standings are transmitted back to the host yacht club and to the officials at the finish line. Here is where amateur radio can take over to relieve the marine frequencies of nonessential traffic.

One amateur radio station can be located on the escort vessel that has all of the



On short races, not too far from shore, a small vhf transceiver can do the job with ease.

clubs throughout the country host both local and long-distance races. Some of these races might be just a day or a weekend affair, such as a run around Long Island Sound, or a race to Catalina Island and back. On short-haul races like these, the club will be looking for radio amateurs to provide race-standing results as the vessels round their check points. Other clubs may sponsor a three-week, 2400-km (1500 mile) race where they will be looking for high-frequency amateur radio communications along the race route, as well as communications at the finish line to transmit the results.

Typical communications for a long-distance race might include weather reports and forecasts, calculated positions of participating boats, roll call, bed check (to ensure that all is well for the night), and race standings. Most of this work is done on 2 and 4 MHz ssb maritime frequencies. When a sailboat is near an escort vessel, they use vhf channels. The whole idea is for escort vessels to keep a close check on each participant to ensure safety while traversing the long race course. There is usually one escort for each ten race participants.

As soon as the escort

weather-reporting equipment. This station will be manned by a guest amateur radio operator who can have some exciting times at sea while providing a useful service. A second amateur radio station can be located aboard the finish-line committee boat. This can be a bit tricky if the end of the race is at a location within the jurisdiction of a foreign country. For instance, Mexico does not have a reciprocal operating agreement with the United States, so amateur operations from finish-line vessels must be done from the high seas. This is something that you'll have to check on



This is not the best location for a vhf transceiver, but it shows that even the smallest craft can have communications (photographs by West, WB6NOA).

before you leave your home port. The amateur radio operator picked for finish-line duty usually has the most fun — he gets to relax until all the vessels are in sight, and then he earns his keep as each vessel crosses the finish line. When it's all over, he can go ashore with the rest of the crew and have a great time.

A third amateur radio station is usually set up at the host yacht club. This may not be the most desirous location to operate from, in that you daily have to answer hundreds of questions as to where the racing vessels are, and "Is Jerry aboard the *Mahia* having a good time and would you mind communicating a short message from his wife?"

Temporary installation of equipment

For the lucky amateur radio operators picked to man the communications package aboard the escort vessel and the finish-line vessel, a good installation is essential. If you're going to be operating on 2-meters for a short race, you'll have no problem with either portable or mobile equipment; plug it in, run your coaxial cable, and feed your signal into

a good half-wave antenna that requires no ground plane. Try to stay away from beam antennas because you never know which direction the captain is going to be heading the vessel. Remember, mobile antennas, such as a 5/8-wave whip, generally require a good ground plane to effectively radiate a 2-meter signal, and the chances are you're not

going to find a good ground-plane surface aboard modern day yachts. If you need that type of antenna, provide it with a ground plane beforehand.

If you're using a 2-meter portable, be sure you never loan it to someone else who may in turn loan it to an unlicensed operator.

Sometimes race committee members feel that since you're the guest, they can just grab a unit and go on the air. Don't let them! Before you start, explain that the only time a nonlicensed person is allowed to speak over the amateur-radio microphone is in the direct supervision of the licensee, and that the licensee must start and end all communications. Make this a firm rule lest you get non-hams on 2 meters.

"Race-committee communications are not necessarily limited to men," comments Susie Foster, WA6BWH. "You just have to be firm when the men want to talk over your ham equipment. They get a bit carried away when there is a close finish. Although I keep my hand-held unit in a plastic bag to keep out the salt spray, that will not prevent the bad language from

Competition is stiff, and emotions are tense when a large number of participants near a check point or a finish line. Amateur radio operators aboard the committee boat can relay the results back to the host yacht club.



creeping through when someone else gets on the microphone. I try not to let it happen!"

For high-frequency operation, 80 and 40 meters are usually chosen for races that may run out as far as 2400 km (1500 miles). On 4800 km (3000 mile) races, such as the Trans Pacific Yacht Race from Los Angeles to Hawaii, 20- and 15-meter capability might be added. Installing a temporary station aboard a race-committee escort vessel or finish-line vessel must be done with some forethought.

The first consideration is where can you go to get away from everyone else. You want to be close enough to the marine ssb equipment so you can hear the participants check in, yet you want to be separated enough so that you may carry on your own communications without interfering with theirs. Remember that everybody onboard will crowd around your ham radio installation as you transmit the race results back to the yacht club. They'll be talking, smoking, drinking, setting their cocktails atop your equipment, and knocking ashtrays over into your antenna tuner; be prepared! Find a corner that will be almost inaccessible to the casual observer, and try to install your amateur-radio equipment there.

Equipment selection

For temporary ship assignments, I prefer solid-state transceivers, rather than tube-type separate units. The Atlas, Swan, Tempo, Ten-Tec, Yaesu, and Heath units are excellent pieces to bring aboard. They're compact, some are completely transistorized,

and they consume small amounts of power at 12 Vdc — the voltage usually found on committee boats. Make sure the equipment you select can take a bit of spray and abuse.

I recommend running the equipment from the ship's 12-volt system, rather than depending on the 110-volt ac generating system that can fail when you need it most. On important races, I usually bring

along my own sealed 12-volt battery in case their battery system should fail or be run down by a refrigeration system that went wild, or was overworked by cooling too much refreshment! Thus, I'm always assured of power independent of the ship's system.

Once the equipment is in place and securely lashed down, anticipating 40-degree rolls, make sure you have a good plastic cover that will fit over it. You can plan on having water leak down from the top of the cabin — it's bound to if seas get rough — and it always seems to leak exactly where you place your equipment. Run your dc power leads, and locate your extra 12-volt battery in a convenient location so that you may make your power switch immediately if theirs should fail.

Amateur radio aboard a race-committee boat has many times saved the lives of those aboard when the other radio gear failed. One incident occurred after the conclusion of a popular Los Angeles to Puerto Vallarta, Mexico, yacht race. Skipper/ham operator Jordy Saunders, operating one of the first FCC temporary calls, WT6AAM, aboard his 45-foot power cruiser, Sonrisa,

recalls, "We got into a 70-mile-per-hour blow you wouldn't believe — it was so wicked it blew overboard our Avon inflatable life raft, my 2- to 8-MHz marine whip, my life rings, and finally my Mosley vertical for 20 and 40. One big wave loomed out of nowhere and crashed into our windshield, completely knocking it out and overboard.

We knew we were in trouble, and had to get a message out that we were turning tail into

the wind and heading for shore 100 miles away. When the wave broke the windshield, it completely took out our marine radios — ssb, vhf, and even our emergency unit, which was destroyed by a hatch cover that fell on top of it. The ham rig, a Kenwood TS-520, was below, and dry, covered by a plastic bag. I fired it up, and then went up on deck to find out why there was no reception. I found we had no antenna — just a broken piece of RG-8/U swinging in the gale winds. I hooked up the center conductor to my lifeline cable that runs completely around the deck, and tried to load up the rig into it with a DenTron tuner. No go — something was wrong.

I then went out on deck to see why I couldn't get even so much as a miniscule signal



Senator Barry Goldwater, K7UGA, enjoys operating on the ham bands from his boat. "Several dB signal improvement when I operate aboard," Barry comments from his *Tobikin* at the Balboa Bay Club.

and found that the lifeline was grounded at one end to a ship's ground chain plate. I took our fire ax and chopped away the connection to ground. My receiver leaped to life with signals all over the band.

A fellow on 20 picked up my weak signals and connected me to the San Diego Coast Guard through his phone patch. We maintained communications all through the night until we were sure we were out of danger. The lifeline — ungrounded — makes a great emergency antenna in a pinch," comments Saunders of the Del Ray Yacht Club.

Ground connections

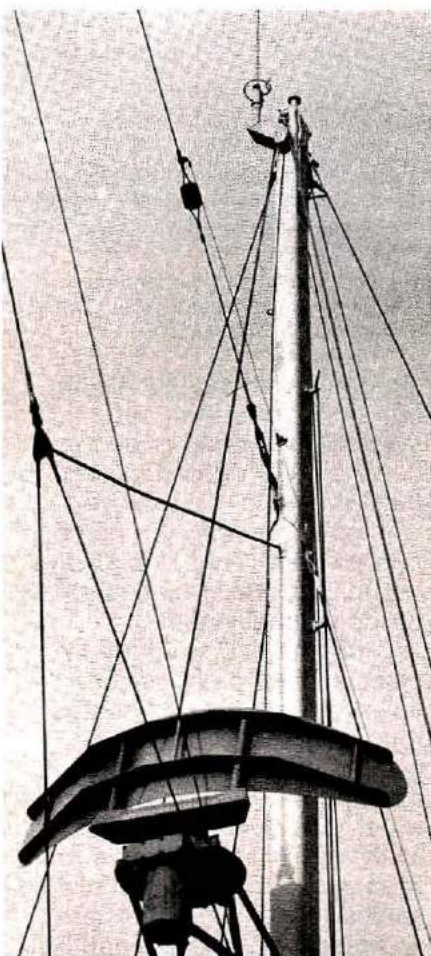
You're going to get some poor results unless you can connect to a sizable ground conductor. If it's a sailboat, and if they have high-frequency marine ssb equipment aboard, take a look at how that equipment operates. If their marine equipment seems to operate well on 4, 6, and 8 MHz, try to tap into the ground system they use. It usually terminates at the keel of a sailboat — an excellent ground point.

However, to the chagrin of the amateur radio operator, most race-committee boats in large and long races are power boats. They usually have a poor ground system because they don't have a large keel surface to use. Again, look for the marine equipment ground connection, and make use of it. If you find that their gear performs poorly because of an inadequate ground system, it's up to you to make your own. Look around for large metal surfaces, preferably those below the water line of your host's power boat. Water tanks are generally located below the water line and offer a sizable amount of coupling to ground. Lifelines that connect to one another around the outside of the vessel are another possibility. Some fiberglass power boats have a metal

ground plate — add this to your system. Finally, you can add the engine and shaft assembly to the total ground, remembering that the engine can be somewhat isolated from the sea water through the oil in the gear box. Make sure that each ground connection is separately run to your transceiver — don't hook them in series. Once you've picked up every bit of metal for your ground connection, then it's time for your antenna run.

Temporary antenna systems

Your first consideration is to keep your high-frequency antenna away from the ship's marine-equipment antenna. This will help prevent cross



Masts on sailboats usually make ideal mounts for either high-frequency or vhf antennas, but you must keep coaxial cable away from trouble spots such as the radar scanner. A 2-meter Ringo antenna has been installed atop the mast for increased range.

modulation and splatter on your receiver when they are transmitting, and vice-versa. Most temporary installations work out well if you can use a mobile antenna in conjunction with a good ground. This means you must take along a ball mount, the long aluminum mast section, and a pair of resonators for each frequency you plan to operate. I say a pair because sooner or later during the trip one of your helpers is bound to lose one overboard! Try to find a good location to mount your antenna system so that crew members will not inadvertently use it as a hand hold while you're transmitting, but also consider that you need a location convenient enough to change resonators when the band goes dead in the early evening. Once the antenna and ground system are ready to go, resonate each whip on the predetermined frequency you plan to use. Make sure your extra whip is also tuned up, ready for immediate replacement when the first one goes overboard.

"I carry three of everything on deck," quips David Metz, of Laconia, New Hampshire. "Three of each coil, three mobile masts, three springs, three of everything when I go out on these committee boats. If I don't lose the coil overboard, the guy I send up on deck will! Last time I went out to do race-committee communications, I dropped my whole 2-meter hand-held rig overboard — and, no, I didn't have three of those!"

Don't be overly concerned about water and spray decreasing the antenna's efficiency when it coats the ball mount. The rf voltage is low at the base section so the effect will be minimal.

Finish-line vessels, permanently anchored in one position with a stern anchor out to prevent swinging on the hook, may use beam antennas.



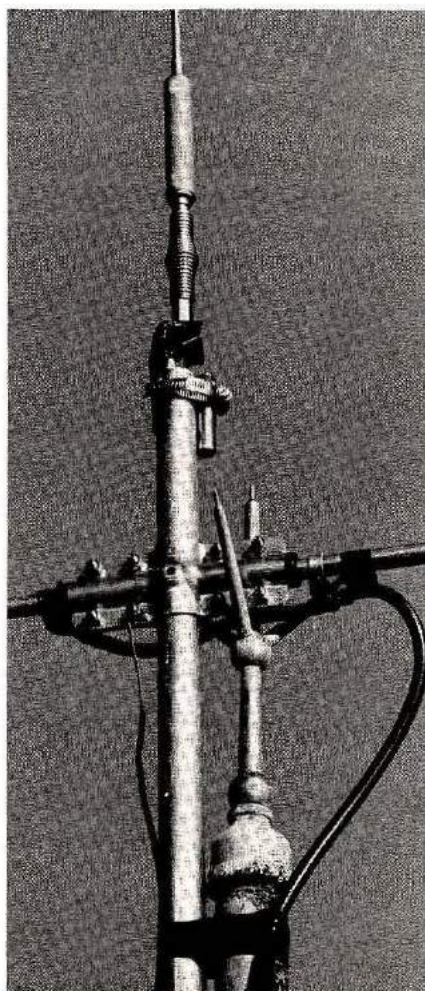
A mobile ball mount provides a versatile system of fastening the whip assembly at a convenient location. You can angle the whip to keep it away from swinging booms.

Small, efficient, beams for portable operation are ideal, and, if mounted on a rotator, will enhance communications back to the yacht club or the escort vessel.

After you've checked out your antenna system and it performs well, apply some silicone sealing compound to prevent corrosion of the copper braid and other connections. Also, make sure that a wayward foot won't inadvertently separate the coax from the antenna. Remember, most mariners and race committee men are not anticipating new obstacles aboard their craft. You're the guest, and an important one, but even so, keep your installations neat and out of the way.

Technician-class ham operator Rod Koral, WB6ORK, recounts a close call when

working with his local yacht club aboard their race committee boat, Dry Lines: "We couldn't quite reach the other ham operator at the club from the distance of our race-committee boat, using two meters simplex. We could hear each other, but not as clearly as I wanted. I decided that my 2-meter whip needed a bit more height, so, with an extra hunk of coax, I started up the small mast of the boat. Reception improved dramatically with the added height, so the top of the mast would do fine. I could hear the club come in loud and clear, and the folks said that the needle was now at S9, up from a low of S1. Just as I was ready



Your temporary installation at the yacht club can use existing structures for antenna support. Here a lightning arrester serves as a mount for both high-frequency and vhf antennas.



If your finish-line boat is anchored to prevent swinging, you can use a rotator and small beam antenna for improved communications with the yacht-club station.

to fasten the whip aloft, the captain decided to fire up the radar. No problem, I thought — I was well clear of the rotating scanner but the coax wasn't! Each revolution of the scanner antenna coiled up about 1 foot of coax. I could see what was going to happen, so frantically I began to undo the extra length of coax draped over and around my shoulder. Time and coax ran out — the scanner pulled all the coax taut, I began to lose my grip, and BANG, the RG-58/U parted! Luckily, I remained aloft. Lesson: watch out for coax runs around radar antennas, especially if you are integrated with that coax!"

Another, similar incident occurred to Bill Alber, WA6CAX, as he was scaling a mast with a long wire coiled over his shoulder. "Someone down below turned on my Atlas 210 and whistled into the

microphone. The rf went up the long wire, around the wire coiled over my shoulder, and gave me an rf burn you wouldn't believe. To add insult to injury, the mariner who whistled into the mike complained that he had never seen such a large CB rig with such poor reception!"

Essential accessories

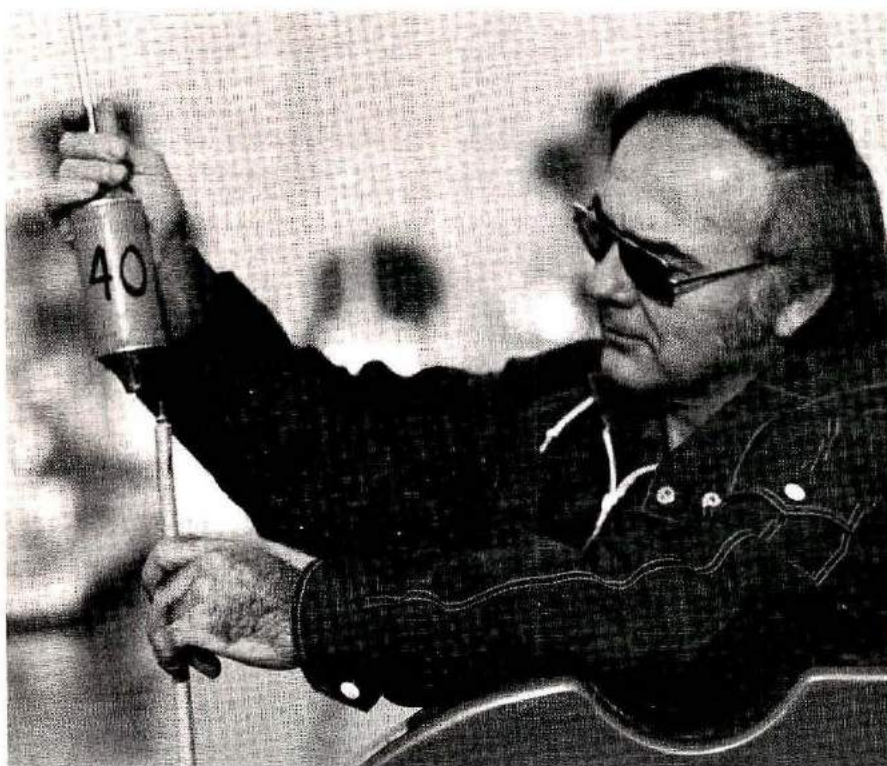
Here is a list of some essential equipment to complement your amateur radio installation:

- Tools, including a battery-operated soldering iron
- Flashlights and batteries
- Extra coaxial cable and grounding straps
- A small back-up transceiver
- Headphones
- Spare microphone
- Fuses
- Power and vswr meter
- Volt/ohm meter
- Antenna tuner
- Extra log books
- Binoculars
- Phone-patch or message forms

I also strongly recommend motion-sickness pills. I know, you never get seasick, but try operating below decks for any length of time in heavy seas and with five people blowing cigarette smoke in your face. If you didn't get seasick before, you will now. Be prepared!

Frequencies and traffic

I generally stay off the popular marine-mobile net frequencies because yacht-race communications is not what they want on their agreed-upon frequencies. Before you start, determine what you feel will be a quiet segment in the 80, 40, 20, and 15 meter bands, and agree on schedule times, bands, and alternatives if the first band might be dead. Make sure you have several set frequencies and set times for



Even aboard a sailboat you can find room for a vertical whip and some radials — if you can convince the captain that it will not interfere with handling the sails.

each band of operation so you're not chasing each other up and down the spectrum when you lose contact.

You will be besieged by crew members, committee men, and yacht-club commodores, all wanting to place phone-patch traffic. Expect at least ten phone patches a day, and make sure you have an agreement with a shore station ahead of time so that they will be happy to pass the traffic. Most yacht clubs have a member who is an amateur radio operator and who likes to stay ashore and handle this type of traffic. No amateur radio operator enjoys getting hit with ten successive phone patches. Don't even ask — it'll save you the embarrassment of being turned down after the second call.

Be careful who you allow to talk over the microphone. Exuberant people talking to their loved ones back home sometimes get carried away. Concerned businessmen many times will ask about office affairs. The yacht club

commodore may want to check with his answering service to pick up any important business-call traffic — don't let them! Don't jeopardize your service.

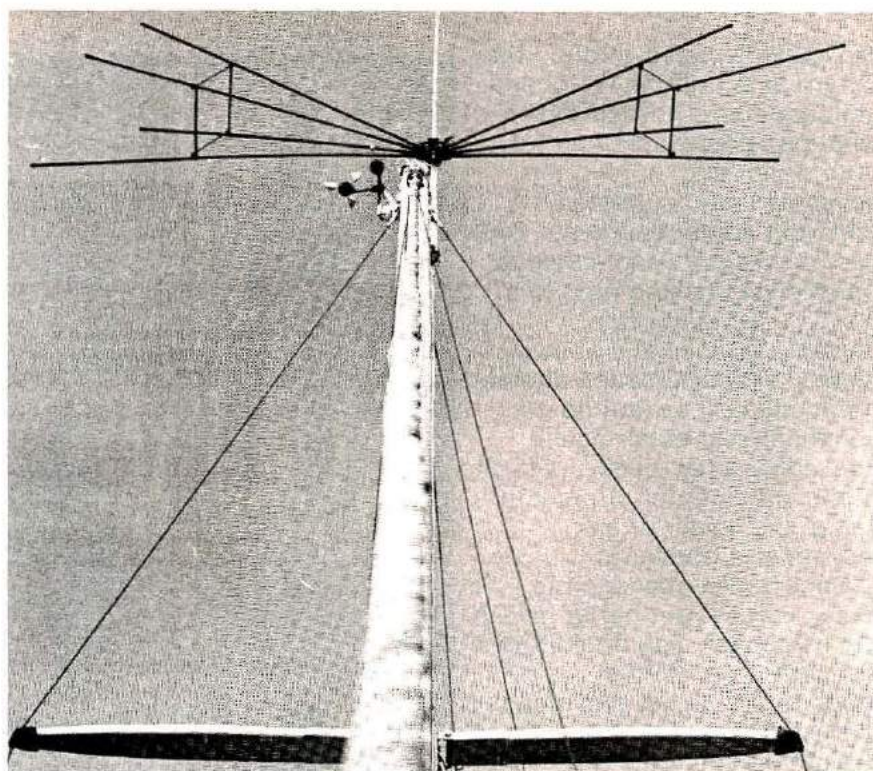
Try to set up some way of managing the phone patch problem; I guarantee it's going to be a problem when you're far out at sea and everybody wants to call home for free. One remedy is to limit phone patches to *very important* matters. Have a sign-up sheet for messages only, and tell everyone aboard you're happy to pass along their message, but will reserve direct phone patches for only the most vital communications. This saves problems at both ends of the radio circuit.

Bon voyage

Once you are out on the briny deep, you're going to find that, although your ship may have medium-frequency and high-frequency ssb marine channels, your amateur radio setup will be the most

important link back to the yacht club. If there is an emergency, try the maritime Coast Guard frequencies first. If you can't get through, then amateur radio is right there ready to help. In 1969 on the Trans Pacific Yacht Race, it was a very water-logged Swan transceiver that saved the life of a crew member who had been smacked in the head with a spinnaker pole aboard the vessel *Mahia*. Our sideband gear on maritime frequencies couldn't get the message across to the Coast Guard because of band conditions. We then switched to amateur radio, and through the expert help of Dave, W6VX, we were able to contact the Coast Guard and save the victim's life. It might be up to you on this next cruise to do the very same thing. Be sure that, at any time and at any hour, you know what frequency and what band you can use to contact a station for immediate help ashore.

After the race is over and your committee boat ties up, you can relax and receive congratulations for a lot of hard work that may not have seemed much like a vacation at sea.



Take along spares of everything, especially those items that could be lost overboard. Loading coils and whips should be pre-tuned for fast band changes.

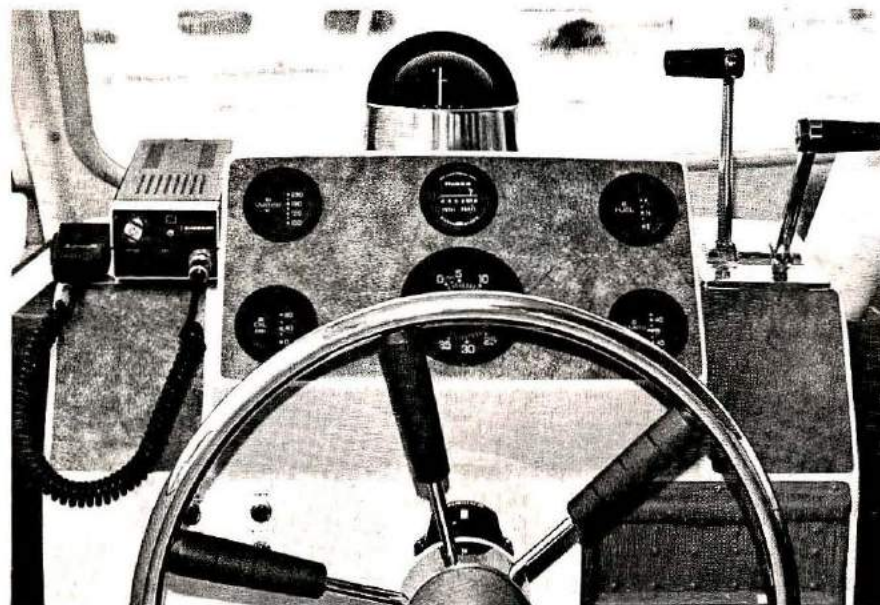
You'll find that your amateur radio operating has been made known to every mariner who participated in the race, and they will now have high esteem for amateur radio operators. The yacht club will

probably invite you back again. If the communications work out, other yacht clubs may contact you to help man their communications in one of their races.

"You hams have a way with the airwaves," states Dr. Tom Redler of the Del Rey Yacht Club. "When we can't get through with all our expensive marine sideband gear, you folks just twirl a few knobs and have us patched through loud and clear. How you do it, I don't know, but that's why we keep inviting you back every year for these races."

Every week I receive at least one phone call from a Pacific Coast yacht club looking for an amateur radio operator who wants to set out on a three-week cruise to help out on communications. Does that sound interesting? If so, check with yacht clubs in your area and tell them you have equipment, will travel!

HRH



On some of the power craft there is a convenient and safe spot for a small vhf transceiver near the control area. Velcro pads or flexible straps should be used to keep the equipment in place during rough seas.

So you've slogged through the fairgrounds fighting October's chill and snow flurries to see what goodies can be had for little or nothing, hoping the season's final hamfest will bring out some real gems. You spot an old but venerable ssb transceiver stacked next to a box of used (and often unmarked) tubes and approximately 200 back issues of electronic magazines (but no complete year sets). You're hooked — a few back-and-forth offers and counter offers later you're the owner of an inexpensive phone rig.

Once you've managed to sneak it past your better half to the hamshack, you hook it up and turn it on. Hmmm . . . so much for bargains. Why doesn't it make a noise?

At this point you have several alternatives. First, you *could* open a six pack and mutter some candid wisdom such as "I always *knew* ssb was . . .," or you could kick the piece of, uh, gear, over into the corner until next October and pawn it off on some other sucker. But that perpetuates the cynical view of the XYL that "These hamfests are places where grown men go to play musical junk every year." Besides, it further injures your already hurt pride. (After all, ol' Fred seems to be able to hack these minor problems . . . why not you?) You certainly don't need that, right?

Another alternative is to pack

NOW THAT YOU'VE GOT IT HOME

BY JOSEPH J. CARR, K4IPV

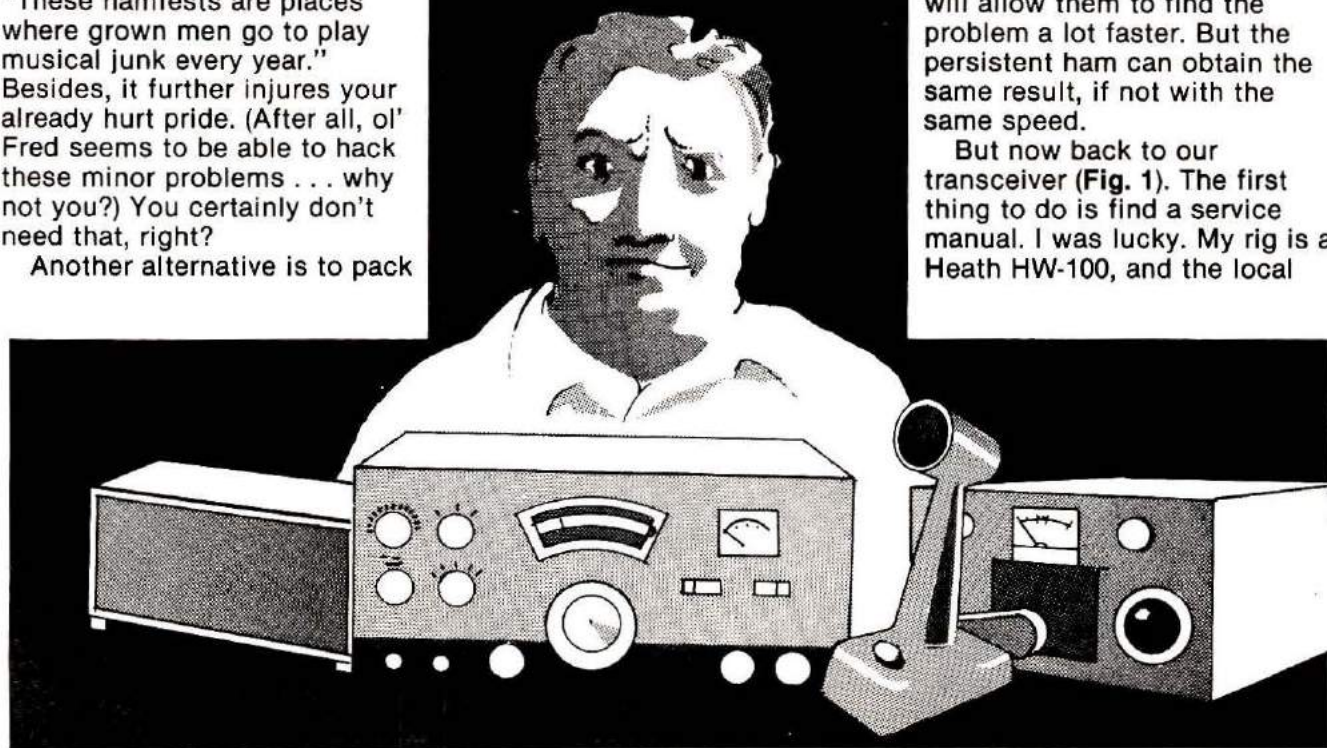
Your radio doesn't work when you bring it home and try it out. It's a flea-market bargain.

up the equipment and send it to the manufacturer or to a ham-radio service shop (of which there are mighty few). Not too good, because it's expensive and time consuming. Good professional communications equipment service can be quite costly and the old rig might not be worth it.

Another alternative is to try *fixing it yourself*. To many, this seems like asking one to try walking on water, and many hams won't even attempt to troubleshoot their own equipment. They seem to feel that electronic trouble-shooting is an arcane art practiced by professionals and others schooled in occult goings on. Not so — read on!

For some time now I've been offering the opinion that *most* amateur equipment repairs are well within the capabilities of most amateurs with a Technician/General class or higher license. Of course, there are some repairs that take a lot of sophisticated multikilobuck equipment and a lot of years of experience. There are other repairs where the troubleshooting acumen of the professional will allow them to find the problem a lot faster. But the persistent ham can obtain the same result, if not with the same speed.

But now back to our transceiver (Fig. 1). The first thing to do is find a service manual. I was lucky. My rig is a Heath HW-100, and the local



Heathkit service center had a copy of the manual for sale. If a manual is not part of the hamfest deal when you obtain the transceiver, try contacting the manufacturer. (Lesson number 1; insist on a manual as part of the deal.) Most companies maintain a stock of manuals for several years after the model is no longer sold, so you'll probably be in luck. In many cases, though, the manufacturer no longer is in business or the model is simply too old to expect them to have a manual for sale. In that case try advertising in a ham magazine and in your local newsletters and club publications.

In the several instances where I've had to acquire a manual by advertising, the results were quite good. For example, I once needed a manual for an old Hammarlund receiver and my single ad brought in four Xerox copies (free) and an original. One of the copies came from a prominent West-coast ham-equipment dealer.

Preliminary chores

While awaiting your manual you can do some clean up and evaluation that will, often as not, put the rig back on the air with almost no troubleshooting.

Fig. 1. Author's acquisition during a buying spree in a local hamfest flea market. It's a popular Heath transceiver, one of the many such radios you'll find offered for sale. Maybe it works; maybe it doesn't. It's easy to find out with some simple checks.



Fig. 2. The first thing is to inspect the chassis against the service manual and make a list of missing or broken parts such as switches, insulators, or electronic parts. Check each component thoroughly. Use a magnifying glass to look for small components. Probe around the wiring with a pencil to ferret out missing or broken components.

Many electronic equipment problems are caused by dirt interfering with the operation of circuits. When this dirt is removed, the rig works.

The first thing is to examine the innards (**Fig. 2**). If any components are missing or obviously broken, make a list of them and try to obtain replacements. Examine the rig for

missing screws (a critical ground not making contact?), burned-out or missing tubes and lamps (lamps often ballast series-parallel filament strings in vacuum-tube sets), and any other component that seems to be missing. In ssb rigs there should be at least one filter. A friend of mine brought home a popular Collins rig and found all filters missing. That act of cannibalism by a previous owner kept the rig from working!

Cleanup

Next, remove the dirt from inside the set. This isn't a trivial "make work" activity. It often results in restoration of an older set. Many defects and faults are a direct result of the assorted debris that seems to infest electronic apparatus after a while.

The first step in the cleaning process is to use a small paint brush (see **Fig. 3**) to loosen and whisk away surface dust. Be gentle, though, because you don't want dust to settle into tube sockets and between variable-capacitor plates. A

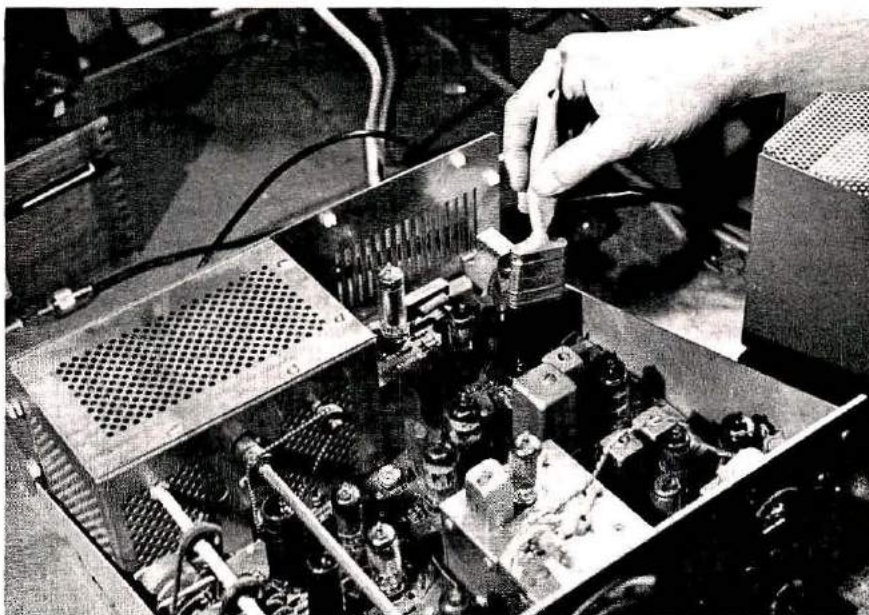


Fig. 3. Cleaning out accumulated dirt is essential. A small paint brush can be used. For cleaning inaccessible areas, use a stiff toothbrush. Blow out the loosened dirt with a compressed-air blast. Easy does it with delicate components!

small vacuum cleaner (for example, I use my wife's *electric broom* with attachments) is good for removing the dust loosened by the paint brush.

If dust and junk are found between variable-capacitor plates you may have a bit of a problem. The dust may short out stator and rotor plates, causing problems that vary from annoyances to spectacularly destructive arcing. One method for removing the dust particles is to blow them out with compressed air (Try your local gas station.) Compressed air in aerosol cans is available in several forms, one of which is the portable air-blast horns used by boating enthusiasts and bicyclists.

Liquid solvents

Never use liquid solvents on variable capacitors, and never disassemble a variable capacitor "for cleaning." Some who have done this have regretted it evermore . . . it seems that the dial calibration was never the same!

Liquid and aerosol preparations have their uses, however, and part of the cleaning process makes use of them. If

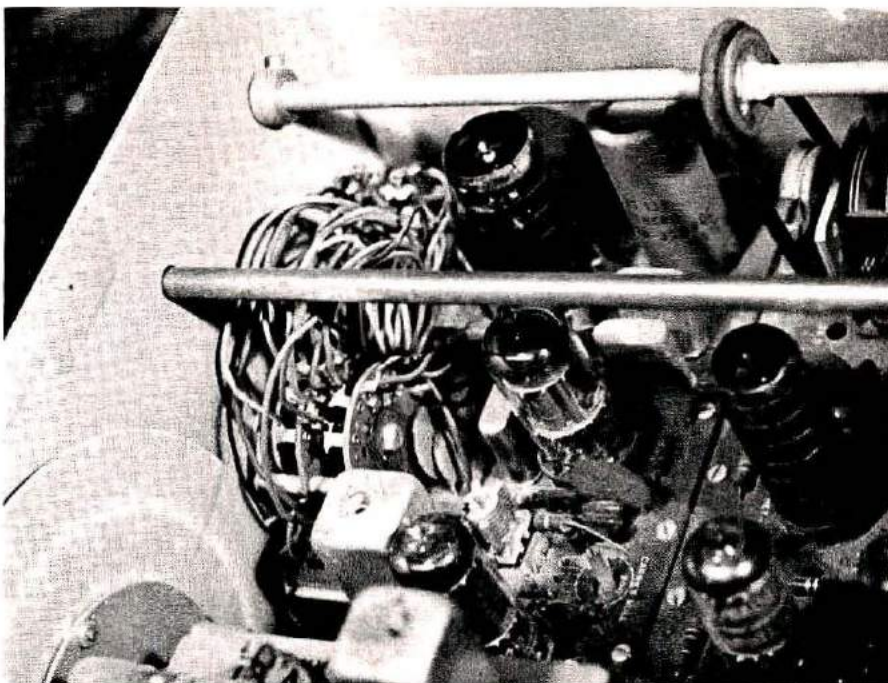
the rig is more than a few years old, or was located near the kitchen, it's a good bet you'll find a thin film of grease on the chassis, printed circuit boards, and most tubes. If the tubes look and feel sticky, grease is present. The grease film retains dirt, so the set will take on a

very cruddy appearance and that dirty film will conduct electrical currents! Rarely will the film have so low a resistance that the results are spectacular. However, the film will form unwanted feedback paths that can cause oscillations, reduced gain, and other problems.

Choose a solvent such as Freon TF, or a radio-TV-electronic circuit *degreaser*. Do *not* use switch-contact cleaner or TV-tuner spray for this application, especially the foam types. These preparations have their uses but are not recommended for general cleaning. Make sure that the preparation you select is safe for use on plastics and painted surfaces and that it doesn't leave a residue. Check it yourself. Don't trust the labels completely.

Next, clean all of the switches and controls (potentiometers) (see **Fig. 4**). Here is where you use those contact cleaner preparations. If you ask professional servicers about any given brand or product, you'll receive answers all the way from "it stinks" to "great stuff." Many have their

Fig. 4. An aerosol solvent can work wonders in cleaning rotary switches and pots. Make sure the solvent you use is approved for use with electronic circuits.



prejudices, but most brand-name cleaners work just as well as any other, even the cheapie house-brand stuff.

Spray the cleaner into the openings of the potentiometer housing and onto the surfaces of the switch contacts (rotary switches). Operate each control or switch vigorously for a few seconds immediately after applying the cleaner. Where the dirt is really bad and is hard to cut, it may be necessary to use a pencil eraser to scrape away the filth and corrosion. The operation should result in a nice, shiny metallic surface where there had once been nothing but black grunge. Be careful, though — those switch contacts are made of light-gauge metal and are easily damaged. They are delicate!

Checking tubes

After the cleaning is finished, test all tubes. Even if the only tube tester available is a drug-store special (an emission rather than transconductance tester), you'll be able

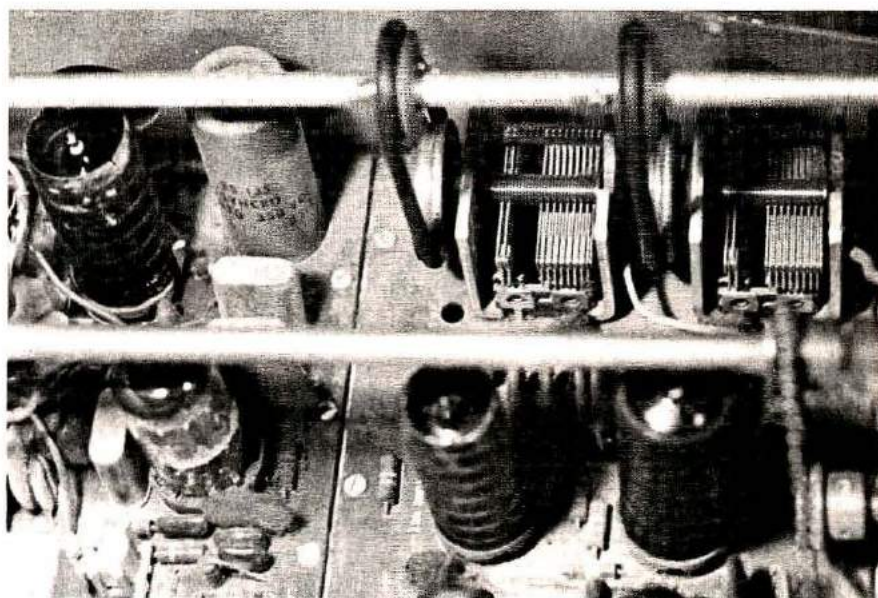


Fig. 6. Inside my transceiver, showing drive belts on capacitor-tuning shafts. If these belts are worn or have cracks, replace them with new ones. Don't compromise — you'll be ahead in the long run with new hardware.

to spot the more gross conditions, such as very low gain and interelement shorts.* These problems tend to show up on even the simplest testers. I am *not* a fan of automatically "retubing" the

set just because it has some age on it, for the simple reason that the largest number of premature faults tend to occur in tubes that are less than 90 days old! So just replace those which are bad, and do yourself a favor: don't use any hamfest auction specials of uncertain origin. Buy new tubes and you'll find fewer oddball problems to solve later.

Be sure to replace any missing tube shields. Many rigs have most of their tube shields missing. This can cause all manner of strange symptoms that are especially difficult to troubleshoot. Tube shields are used for a purpose. They

Fig. 5. Test all tubes. Don't forget the final-amplifier tubes, which may be easy to overlook. It's easier and safer to replace these essential tubes with new ones than to rely on supermarket tube checkers.



*Don't forget to check the final-amplifier tubes. These tubes are easy to overlook in many transceivers because of packaging, **Fig. 5**. Most drug-store tube checkers probably don't include these tubes in their tube lists. Even if they do, the results obtained are not necessarily indicative of such tube performance in a radio-frequency amplifier. You can take your final tubes to a fellow ham whose set uses such types and ask him to check them out in his rig. If his final tubes are working ok, it's easy to compare results with your tubes. Filament emission is probably the biggest cause of low output in final-amplifier tubes. If you're still in doubt, it's best to buy new final tubes.

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isolate stages to reduce mutual interaction because of coupling between the tubes. The shields will keep one tube's field at home, while preventing fields from other tubes from getting into the circuit. Some types of tube shield are difficult to reinstall, so many servicers simply forget them — a very bad practice!

Miscellaneous hardware

The last step is to perform a general check of set screws, knobs, shaft couplings, fiber or nylon fittings, and rubber drive belts (see Fig. 6). Tighten screws and replace those that are missing. Make sure everything is tight and shipshape. If replacement rubber belts are not available from the rig's manufacturer, try using one from a phonograph or tape player. These are often available in sizes close enough to perform adequately. Check local wholesalers who deal with the radio-TV service trade.

Old drive belts can often be reclaimed unless they're deeply cracked and on the verge of breaking. Those same wholesalers sell a liquid rubber rejuvenator called *Vita-Drive*, which does a good job. It's intended for refurbishing tape-recorder and phono-drive components. Smear it on and let it soak in for a few minutes, then wipe off the excess.

The moment of truth

Once cleaning is finished, test the rig to see if it works properly. Don't be terribly surprised if the rig works a lot better now than it did before you started! This is not just a psychological boost of the sort that claims your car actually runs better following a wash and wax job. The dirt and grease really *do* deteriorate performance, even to the point of killing operation altogether. Dirt on those switch contacts, for example, can render the switch effectively "open." Nondecoupled current paths over a film of dirt and grease can cause regeneration that

shows up as birdies and other audible oscillations, as well as silent oscillations, which reduce stage gain by quieting the receiver. Remove the dirt and grease and you remove the source of the problem.

But what happens if the set still refuses to resuscitate? At *that* time, a more detailed and sophisticated troubleshooting procedure is required. But even that's not an insurmountable task. It indicates that the rig should be sent to the shop. If troubleshooting proceeds, usually by signal injection or signal tracing in an orderly and logical manner, success should be close at hand.

Before doing anything, however, "desk check" the set by analyzing the block diagram and schematic in terms of known symptoms. Some stages are used in the transmitter only, others in the receiver only, and still others in both receiver and transmitter. If a trouble is known to exist in either or both sections, then about one third to one half of the stages can be excluded from consideration.

Remember, all electronic-circuit troubleshooting involves one or both of two things: finding a *missing* path for current or an *unwanted* path for current. It's in finding these open and short circuits that the successful troubleshooter excels.

HRH



"Oh we have a very small apartment. It's decorated in early ham."